PB-230 470

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS, LITTLE CYPRESS CREEK RESERVOIR, TEXAS

Public Health Service
Dallas, Texas

August 1960

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 230 470

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

LITTLE CYPRESS CREEK RESERVOIR

TEXAS

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas Dallas, Texas

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District - New Orleans, Louisiana

AUGUST 1960

TABLE OF CONTENTS

	Page
LIST OF TABLES	iii
LIST OF FIGURES	iv
INTRODUCTION	
General	1
Acknowledgments	1
SUMMARY AND CONCLUSIONS	2
DESCRIPTION OF AREA	
Geography	4
ECONOMICS	5
Extractive Industries	5
Manufacturing Industries	7
Retail Trade and Service Industries	8
Population	9
DEVELOPMENT OF LITTLE CYPRESS CREEK AREA	11
Water Sources	13
Water Quality	14
Water Uses	15
SOURCES OF POLLUTION	17
WATER PLAN	19
Longview	19
Marshall	20
Gilmer	21
Impoundment Protection	21

TABLE OF CONTENTS (Continued)

Page

APPENDIX

Basic Data Used in Calculations . . . . . EXHIBIT A

BIBLIOGRAPHY 22

LIST OF TABLES

		Page
Table 1.	Value of Mineral Production, Gregg, Harrison, and Upshur Counties, Texas, 1952-1958 . . .	5
2.	Value of Crops and Livestock Sold, Gregg, Harrison, and Upshur Counties, Texas, 1944, 1949, 1954	7
3.	Number of Firms by Size and Type of Manufacturing, Gregg, Harrison, and Upshur Counties, Texas, 1947 and 1954	8
4.	Total Sales Volume of the Retail and Service Industries, Longview, Marshall, and Gilmer, Texas, 1948 and 1958	9
5.	Existing and Forecast Populations, Longview, Marshall, and Gilmer, Texas, 1960-2010 . . .	12
6.	Estimated Water Demand (mgd), Longview, Marshall, and Gilmer, Texas, 1985 and 2010	12
7.	Stream Flows - Little Cypress Creek	14
8.	Water Quality - Little Cypress Creek	15
9.	Municipal Water Supplies in the Vicinity of Little Cypress Creek	16

LIST OF FIGURES

		Following Page
Figure 1.	Vicinity Map - Little Cypress Creek Reservoir	4
2.	Population Trends and Forecast - Little Cypress Creek Reservoir	9

INTRODUCTION

General

In a letter dated February 11, 1959, the District Engineer, U. S. Army Engineer District, New Orleans, requested the Public Health Service, Region VII Office, Dallas, Texas, to prepare a preliminary evaluation of the need for water supply storage and its value (benefits) for the following streams:

1. Cypress Creek above Ferrells Bridge Reservoir.
2. White Oak Creek.
3. Little Cypress Creek.
4. Bayou Dorcheat.
5. Black and Cypress Creeks.
6. Bayou Bodcau.

Little Cypress Creek is considered in this report, and the other streams are considered in separate reports.

Acknowledgments

Acknowledgment is gratefully made for the assistance of the Texas State Department of Health, the Bureau of Business Research of the University of Texas, the Texas Board of Water Engineers, the New Orleans District of the Corps of Engineers, and the city officials and Chambers of Commerce of the following cities: Gilmer, Gladewater, Hallsville, Longview, and Marshall, Texas.

SUMMARY AND CONCLUSIONS

1. The proposed reservoir site is located on Little Cypress Creek, in Upshur County, northeastern Texas, approximately ten miles north of Longview.

2. Each of the three major communities in the project areas, Longview, Marshall, and Gilmer, have experienced considerable growth. It is expected that this growth will continue and will be accompanied by increased water requirements.

3. Projections to the year 2010 indicate that storage to yield 90 mgd for municipal and industrial water supply purposes is needed in the Little Cypress Creek Reservoir.

4. The value of storage in Little Cypress Creek Reservoir to yield 90 mgd municipal and industrial water is estimated to be 0.88 cents per 1000 gallons. This value is based upon a cost of 1.06 cents per 1000 gallons to Longview for 43 mgd from Cherokee Lake and 0.7 cents per 1000 gallons to Marshall for 42 mgd from Ferrells Bridge Reservoir. The latter individual values are founded on the cost of storage at the most reasonable alternative source of supply and the difference in transmission costs.

5. While it would appear to be more economical for Gilmer to develop additional wells to meet its expected water demand expansion to 6 mgd, the community has expressed considerable interest in obtaining a surface water supply. Storage for municipal and industrial water supply in the proposed reservoir compares favorably in cost with Gilmer's proposed single-purpose reservoir on Little Cypress Creek (upstream from the Corps site).

6. The city of Gilmer discharges its municipal wastes after primary settling and lagooning to Little Cypress Creek, upstream from the proposed Corps project. Increased waste flow emanating from the

expected industrial and population expansion presents a potential pollution hazard to the use of the project for municipal and industrial water storage. The effect of this discharge could be minimized by providing a high degree of waste treatment and an outfall line discharging the treated waste downstream from the dam to bypass the proposed impoundment.

7. Both Longview and Marshall discharge treated municipal and industrial waste to the Sabine River Basin. It is estimated that the increased waste loading expected in 2010 will require a flow of approximately 105 cfs at Longview to maintain minimum dissolved oxygen objectives in this stretch of the Sabine River.

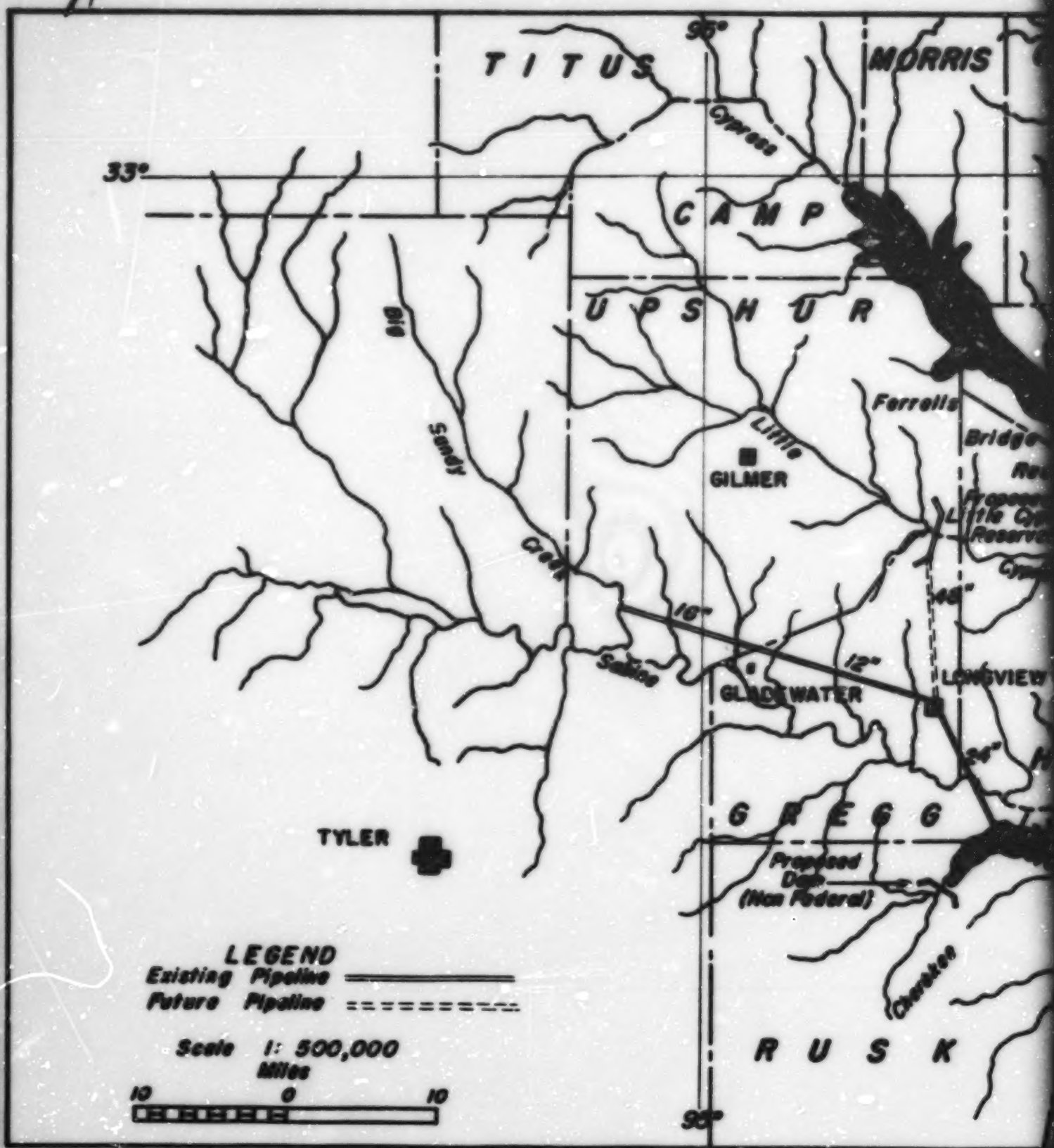
DESCRIPTION OF AREA

Geography 1/

Little Cypress Creek is located in northeast Texas in the Red River Basin. The headwater tributaries of Little Cypress Creek originate in western Camp County, extreme eastern Wood County, western Upshur County, and several of the tributaries converge to form Little Cypress Creek at a point northeast of Gilmer. The stream flows in a southeasterly direction through eastern Upshur County, eastward through one-third of Harrison County and then northeastward until it joins Cypress Creek in the backwaters of Caddo Lake about six miles east of Jefferson. Figure 1 shows the location of the proposed Little Cypress Creek Reservoir and the area under consideration. Little Cypress Creek is approximately 64 miles long and drains an area of about 696 square miles. 2/ The Creek has fairly deep cut banks, and the flood plain is bordered by low hills. There is considerable growth of hardwood in the immediate flood plain.

The average annual rainfall in the area is 40 to 45 inches. Most of the annual flow in Little Cypress Creek occurs during the spring wet season and during heavy showers in the early summer. Frequently, there are long periods in the summer and fall when there is little or no flow. 3/

A


TITUS
MORRIS
CAMP
UPSHUR
GREGG
RUSK
95°
33°
Cypress
Big Sandy Creek
Little
Ferrells
Bridge
GILMER
16"
12"
24"
Sabine
GLADEWATER
LONGVIEW
TYLER
Proposed Dam (Non Federal)
Cherokee
LEGEND
Existing Pipeline
Future Pipeline
Scale 1: 500,000
Miles
10 0 10

B 4-a

LITTLE CYPRESS CREEK RESERVOIR
VICINITY MAP
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE PUBLIC HEALTH SERVICE REGION VII DALLAS, TEXAS

FIGURE 1

ECONOMICS

The primary water demand centers for the proposed Little Cypress Creek Reservoir are the cities of Gilmer, Longview, and Marshall, Texas. Population growth and industrial development are, in large, a function of the natural resources of the area, the current industrial base, and the market situation. A demographic and economic analysis of the three counties within which these cities lie, therefore, will help explain the past growth trends of these cities and will also give a good indication of the future growth potential. The term, "three-county area," refers to Gregg, Harrison, and Upshur Counties.

Extractive Industries

Minerals

The extraction of mineral resources is an important activity in the economy of the three-county area. Gregg County in 1958 was the State's third ranking oil-producing county and fourth ranking in the total value of minerals produced. The total value of petroleum, natural gas and natural gas liquids extracted in the three counties has been averaging nearly $190,000,000 annually for the last seven years. See Table 1.

Table 1

Value of Mineral Production 4/
Gregg, Harrison, and Upshur Counties, Texas
1952-1958
(Figures in millions of dollars)

Counties	1952	1953	1954	1955	1956	1957	1958
Gregg	$163	$169	$156	$151	$148	$128	$135
Harrison	11	15	15	17	20	23	20
Upshur	11	11	10	10	9	66	33
TOTAL	$185	$195	$181	$178	$177	$217	$188

Production of crude petroleum in the East Texas Oil Field totaled 53,000,000 barrels in 1959. Estimated reserves in this field are 1.7 billion barrels or enough to sustain the present rate of extraction for thirty-two years. 5/ Explorations are continuing. During 1957-1958, 540 wells were drilled of which 471 were producing. 4/ At present there are approximately 18,850 wells in the three counties. In addition to oil and gas extraction, there is some mining of shale, fire clay, and lignite.

Forest Resources 6/

The three-county area has 562,200 acres in commercial forests, principally pine and oak. Standing saw timber in this area totals 525,900,000 boardfeet. The present annual logging rate is approximately 20-25 million boardfeet of saw timber and an additional 90-100 thousand cords of pulpwood. The rate of growth is greater than the harvest.

Agriculture 7/

The role of agriculture in the economy of the three-county area has been declining. Not only has the number employed been decreasing, but the number of farms, the acreage of cropland harvested, and the combined value of crops and livestock sold has also been decreasing. The number of farms has steadily decreased from 8,267 in 1945 to 5,331 in 1954. Although the average size of the farms has increased from 85 acres to 132 acres during this period, thereby appearing to compensate for the decrease in the number of farms, the amount of farm production fell off significantly. The acreage of cropland harvested dropped from approximately 146,000 in 1944 to 109,000 in 1949 and continued to drop to 62,000 in 1954. The value of crops sold increased between 1944-1949, but fell off sharply between 1949-1954. The value of livestock has continued to increase. However, the combined value of both crops and livestock shows a decrease of 23 per cent between 1949-1954. See Table 2.

Farm employment in recent years is continuing the declining trend. The number in the labor force working on farms was 6,375 in 1955 and 5,900 in 1959. 8/

Table 2

Value of Crops and Livestock Sold 7/
Gregg, Harrison, and Upshur Counties, Texas
1944, 1949, 1954
(Figures are in thousands of dollars)

Year	Value of Crops Sold	Value of Livestock Sold	Total
1944	1,972	2,154	4,126
1949	3,105	3,461	6,566
1954	1,357	3,694	5,051

Manufacturing Industries 9/

The manufacturing base of the three-county area has had an expanding trend. Average plant size, the number of employees, and the value of the output have all increased. Table 3 shows the number of plants in each category for the years 1947 and 1954.

The data indicates that there has been an expansion in number and/or size of all types of manufacturing plants with the exception of those engaged in the manufacturing of lumber and wood products. Since 1954, growth has been evidenced in most of the categories listed in Table 3. Investments in plant and equipment in 1958 alone totaled $12,500,000.

The number of workers employed in manufacturing rose from 5,447 in 1947 to 6,177 in 1954, and again advanced to 9,880 in 1959. 10/ The value added by manufacturing reflects the growing importance of manufacturing to the economy of the three-county area. It advanced from $19,284,000 in 1947 to $70,251,000 in 1958. When adjusted for the change in the value of the dollar, the value added by manufacturing was $56,812,000 or nearly 200 per cent more in 1958 than it was eleven years previous.

Manufacturing has made important contributions to the growth of Longview and Marshall. The number of employees engaged in manufacturing in Longview increased from 632 in 1947 to 702 in 1954. During the same period, the value added to manufacturing increased to $5,281,000 or 100 per cent. Since 1954, the number employed in manufacturing has more than doubled. The Chamber of Commerce reported that four new plants with over 100 employees each and three others averaging fifty employees each have been added to the manufacturing base of Longview. The increase in manufacturing capacity

and employment in Marshall has not been as spectacular, but is nevertheless significant. Two firms doubled their employment and have joined five others with over 100 employees.

Table 3

Number of Firms by Size and Type of Manufacturing 9/
Gregg, Harrison, and Upshur Counties, Texas
1947 and 1954

Type of Manufacturing Firms	Number with 20-99 employees		Number with over 100 employees		Total Number of firms with over 20 employees	
	1947	1954	1947	1954	1947	1954
Food and kindred products	8	10	-	-	8	10
Apparel & related products	-	1	1	1	1	2
Lumber and wood products	21	9	4	2	25	11
Printing & publishing	3	4	-	-	3	4
Chemicals & products	-	-	1	3	1	3
Petroleum & coal products	5	5	-	-	5	5
Stone, glass, & clay products	3	4	-	-	3	4
Primary metal industries	2	-	2	3	4	3
Fabricated metal products	-	3	-	-	-	3
Machinery, except electrical	1	3	2	1	3	4
Miscellaneous manufacturing	1	-	-	1	1	1
TOTAL	44	39	10	11	54	50

Manufacturing capacity also increased in Gilmer. In 1954, there were two plants each employing between 20-99 workers. Since then, two additional manufacturing plants of that size have been added along with two smaller ones.

Retail Trade and Service Industries 11/

Commercial development goes hand in hand with industrial development. The retail trade and service industries have shared in the growth of the three-county area as evidenced by the increase in the value of sales. It increased from $119,000,000 in 1948 to $166,000,000 in 1958, which when adjusted for the change in the value of the dollar was an increase of $20,000,000 in ten years. The number of retail service establishments and employees did not increase proportionately, indicating the sales volume per establishment and per employee increased.

Table 4 depicts the growth of sales in the retail and service industries for the cities of Longview, Marshall, and Gilmer. The increase in the value of sales, when adjusted for the change in the value of the dollar, has been proportionately greater than the increase in the population of the three-county area which would suggest that these cities are now serving a larger proportion of the market and/or a larger market area.

Table 4

Total Sales Volume of the Retail and Service Industries [11]
Longview, Marshall, and Gilmer, Texas
1948 and 1958

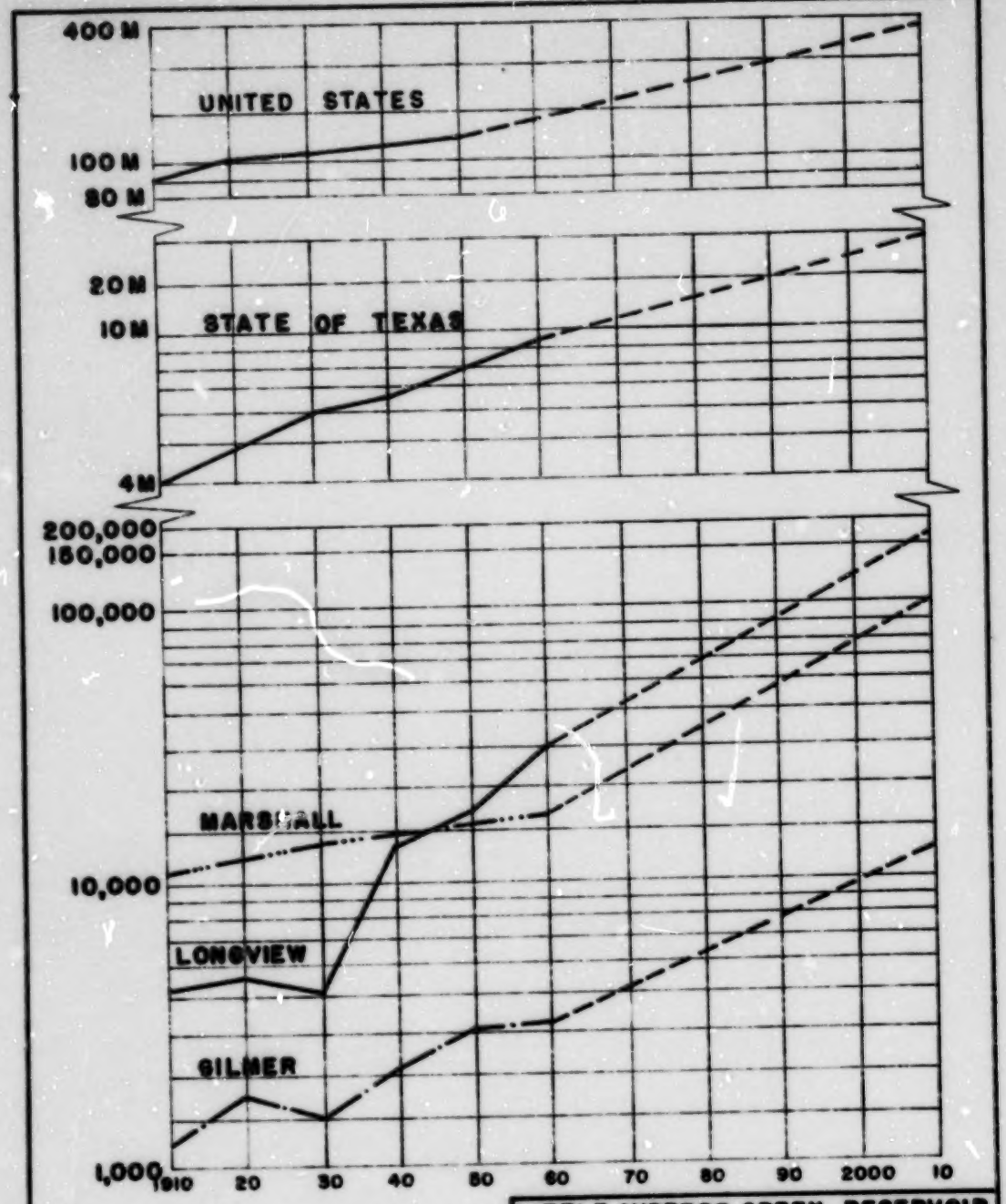
	1948	1958*	1958
Longview	$38,270,000	$51,193,000	$ 61,500,000
Marshall	24,779,000	29,063,000	34,915,000
Gilmer	8,217,000	7,092,000	8,520,000
TOTAL	$71,366,000	$87,348,000	$104,935,000

*Adjusted to 1948 value of the dollar.

Population [12]

Two diverse directions have been manifested in the population trends in the three-county area. From 1940 to 1960, the combined populations of the municipalities has doubled whereas the population living outside of cities and towns has dropped to nearly half. Prior to 1940, the population of both the municipalities and the rural area increased. The total population of the three-county area has had an increasing trend from 1910 to 1960. (See Figure 2). It more than doubled during this fifty-year period. As mentioned, the large part of this increase has been in the cities and towns, which in 1910 had a combined population of 18,059 and in 1960, an estimated 106,000. The significance of the trend toward urbanization in this area is indicated by the change in the relative number living in cities and towns -- in 1910, 25 per cent lived in municipalities, whereas in 1960, it was an estimated 71 per cent.

The cities of Longview, Marshall, and Gilmer have followed the general trend. The population of Longview remained essentially stationary between 1910-1930, then it grew rapidly from 5,036 in



LITTLE CYPRESS CREEK RESERVOIR

POPULATION TRENDS AND FORECAST

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE 2

1930 to 24,502 in 1950. In 1960, the population of Longview was 40,060. A large part of the gain resulted from the annexation of an unincorporated area in December, 1958, which had an estimated 7,000 inhabitants. Marshall experienced a steady increase from 11,452 in 1910 to 25,809 in 1960. In the last thirty years, Gilmer has increased approximately 115 per cent to a present population of 4,306. All three cities have grown faster than average for cities of their size in Texas.

DEVELOPMENT OF LITTLE CYPRESS CREEK AREA

The population of the nation is expected to double between 1960 and 2010. This will mean a vast increase in the need for goods and services in the next fifty years. All parts of the nation will continue to contribute to the needs, but the rate of increase in production will not be uniform in all areas. Obviously, the more favorably a community is endowed with factors which enhance its ability to produce and distribute goods and services, the greater will be its likelihood of growth. An examination of the ability of the study area to meet the increased demands will, then, assist in forecasting future growth of Longview, Marshall, and Gilmer. This section will cite the growth expectations in the extractive, manufacturing, and service industries and the resultant population prediction.

The area is endowed with some natural resources for which a considerable increase in demand is anticipated: petroleum, natural gas, and timber. Estimated reserves will permit the present high rate of petroleum and natural gas extraction to continue for many years, and an increased rate of extraction of saw timber and pulpwood can be sustained. Other resources which have promise for expanded use are the fertile soils and the deposits of clay. An increase in both crop and livestock production is anticipated and the clay deposits hold promise for increased fire brick and pottery production.

The growth and increased diversification of the manufacturing base will continue. Production is expected to increase in resource-based industries, particularly in food processing, wood products, chemicals, petroleum, and clay products. In addition, market-oriented manufacturing plants will develop as population in the market area increases. The most promising are apparel, metal products, and machinery. Trade and service industries will continue to grow with the area.

The economic climate for industrial and commercial growth in the study area is favorable. The local as well as the national markets are expanding. Good transportation facilities are available. All three cities are served by railroads and an excellent highway system. Fuel and power are available at relatively low cost. The area has ample reserves of natural gas which can be supplemented with lignite from local deposits if needed.

The population is estimated to increase steadily between 1960 and 2010. See Table 5.

Table 5

Existing and Forecast Populations
Longview, Marshall, and Gilmer, Texas
1960-2010

	Census 1960	Forecast 1985	Forecast 2010
Longview	40,060	84,000	165,000
Marshall	25,809	51,000	100,000
Gilmer	4,306	8,000	16,000

Attendant to the expanded industry and population growth will be a marked increase in municipal and industrial water requirements. Development of estimated water demand for the major communities in the study area is illustrated in Table 6.

Table 6

Estimated Water Demand (mgd) [13,14/]
Longview, Marshall, and Gilmer, Texas
1985 and 2010

	1985	2010
Longview		
Nonindustrial	14.0	25.0
Industrial	25.0	44.0
Total	39.0	69.0
Marshall		
Nonindustrial	7.5	15.0
Industrial	16.0	30.0
Total	23.5	45.0
Gilmer		
Nonindustrial	1.5	2.4
Industrial	2.0	3.6
Total	3.5	6.0

Water Sources

Ground Water

Some community water supplies in this area are obtained from underground sources. Quality of this ground water is fair, as indicated by total dissolved solids which range from 200 ppm to 700 ppm. [15] The quality falls within the limits of the Public Health Service Drinking Water Standards. [16] The Carrizo-Wilcox sand is the principal water-bearing formation in the Little Cypress Creek basin. Wells in this area at depths of approximately 50 feet have capacities ranging from 50 to 500 gpm and recharge characteristics are favorable. [17,18] The total quantity of ground water which may be safely developed perennially from any given area can be determined only by special investigations.

Surface Water

Flow data available for Little Cypress Creek are limited to several measurements in recent years and daily stage readings. Three stations are operated by the Corps of Engineers. These are located near Jefferson at mile 8.6, near Marshall at mile 19.7, and near Gilmer at mile 39.8, river miles being measured from the mouth of the stream.

Records of stages on Little Cypress Creek at Highway 154, east of Gilmer, and just upstream from the proposed project site, are available for a period from March, 1948, to October, 1952, and from December, 1956, to date. Data on observed discharges have been obtained at monthly or greater intervals at this station from 1953 through 1958. Flows varied from zero to 7,250 cfs. [3] During this period, 67 observed discharges may be arrayed as shown in Table 7.

The gaging stations near Jefferson and Marshall also show periods of zero flow.

Cherokee Lake is approximately eleven miles southeast of Longview, south of the Sabine River. (Longview is north of the river). The lake is formed by a dam on Cherokee Bayou, a tributary of the Sabine River. The lake is owned by a private company which sells water to Longview. The firm yield is reported to be about 35 mgd.

Big Sandy Creek, a tributary to the Sabine River, is located about 21 miles west of Longview (approximately ten miles west of Gladewater). At the present intake used by the city of Longview (emergency use only), it is said to have a firm yield of about 5.0 mgd without impoundment.

Table 7 3/

Stream Flows - Little Cypress Creek

	Number of Observations		
	1953-4	1955-6	1957-8
Flows greater than 100 cfs	9	5	18
Flow less than 100 cfs and greater than 10	2	8	10
Flow 10 cfs or less but greater than 0	0	3	0
Zero flow	2	9	1
TOTAL	13	25	29

Ferrells Bridge Reservoir is located a little more than fourteen miles northwest of Marshall. The reservoir is formed by a dam on Cypress Creek. There are 251,000 acre-feet of water supply storage in this project. The unassigned firm yield is in excess of that required in the area under consideration.

A tributary arm of Caddo Lake on Cypress Creek serves as a source of supply for Marshall. This source is limited to a firm yield of about 3.0 mgd. The transmission main from the intake to Marshall has a capacity of 3.0 mgd.

Water Quality

Chemical water quality data on Little Cypress Creek have been obtained by the Texas State Department of Health at the gaging station near Jefferson, approximately 30 miles below the tentative dam site. Extremes and averages in the analyses of 31 samples collected during the period September, 1957, to March, 1959, at bi-weekly intervals, are shown in Table 8.

The chemical quality of water does not vary greatly during high and low flow rates, being consistently suitable for municipal and industrial water supply purposes.

Table 8

Water Quality - Little Cypress Creek

	Minimum	Maximum	Average
Total Solids	43 ppm	216 ppm	126 ppm
Chlorides	12	92	40
Sulfates	4	29	17
pH	6.8	8.3	--

Water Uses

Communities considered as potential users of water supply from the proposed Little Cypress Creek Reservoir are the cities of Longview, Marshall, and Gilmer, and some 15 smaller communities, most of which do not have community water supplies. In addition, industries located in these municipalities are potential users of the water. Current water use is included in Table 9.

Table 9 13,20/

Municipal Water Supplies in the Vicinity of Little Cypress Creek

	Longview	Marshall	Gilmer	Gladewater	Hallsville
1950 Population	24,502	23,227	1,371	5,305	617
Present Water Supply Source	Cherokee Lake & Big Sandy Creek	Caddo Lake & Cypress Creek	Wells	Lake Gladewater	Wells
Firm Yield (mgd)	55	3*	2.0	---	0.25
Present Water Use (mgd)	4.0	3.0	0.5	0.73	----
Nonindustrial Water Need in 2010 (mgd)	25.0	14.8	2.4	2.0	----
Industrial Water Need in 2010 (mgd)	44.0**	30.2	3.6	---	----
Water Supply to be Developed (mgd)	43.0	42	4.0	---	----
Probably Source of Additional Water	Same as present or Little Cypress Creek	Little Cypress Creek or Ferrells Bridge Reservoir	Little Cypress Creek or Additional Wells	---	----

*Approximate capacity of existing transmission pipe.
**20 mgd will be obtained by local industry through development of other sources of supply.

SOURCES OF POLLUTION [21]

Of the various municipalities located within the potential service area of the proposed project, only Gilmer disposes of wastes to Little Cypress Creek. Wastes from the Longview and Marshall areas are discharged to the Sabine River Basin. [23]

Gilmer's present waste treatment facilities, serving 3,900 persons, consist of an Imhoff tank followed by a waste stabilization pond. The treated effluent is released to Little Cypress Creek at a point just upstream from the proposed reservoir site.

The increased sanitary and industrial waste production created by Gilmer's future growth can be expected to cause oxygen depletion in the upper reaches of the reservoir during periods of low stream flow. Further, the inclusion of treated wastes in the reservoir's yield decreases its desirability as a source of municipal water supply when waste-free sources are available at slightly higher costs. The predicted waste loading for Gilmer in the year 2010 would depress the dissolved oxygen content below 4.0 ppm when the stream flow at Gilmer drops below 10 cfs. This result is based on an assumed 90 per cent reduction in waste concentrations through Gilmer's treatment plant. The stream flow data presented in Table 7 indicates that approximately 22 per cent of the observations over the 6-year period were less than the required flow to maintain minimum water quality objectives in the proposed impoundment. Although these conditions may not produce a nuisance nor appreciably impair the quality of the municipal and industrial water stored, it would seem warranted to consider alternative means for disposal of Gilmer's wastes.

In order to maintain the quality objectives of the municipal and industrial water to be stored in the Little Cypress Creek Reservoir, an outfall could be extended from Gilmer's waste treatment plant around the impoundment to a point downstream from the proposed dam. A high degree of treatment plus chlorination should be provided for the Gilmer waste to minimize the waste load in Little Cypress Creek downstream from the project. An estimated minimum flow of about 5 cfs will be required in the stream during summer months to maintain water quality objectives under these circumstances. Flow in excess of this amount (5 cfs or 3.2 mgd) would be required to serve Marshall's municipal and industrial water needs in the year 2010.

Feasible alternatives would be: holding of treated wastes in large lagoons during low flow periods for release at more favorable times; or pumping the treated waste to a suitable point on the Sabine River watershed. The first alternate, while providing a possible solution to the dissolved oxygen depletion problem, still renders the storage space less desirable than that receiving no wastes. The second alternate appears to be more costly on a continuing basis; and presents the problem of transferring waste disposal to an adjoining watershed (which may already be overloaded with wastes).

The cities of Longview and Marshall discharge their wastes to the Sabine River Basin. The wastes from Gladewater, Kilgore, and various industries in the area being included, the discharge for the Sabine River required in 2010 to maintain minimum water quality objectives is estimated to be about 105 cfs, at Longview, during the summer. Somewhat less flow would be required during the winter. The stream flow is given to show the general range of flow required. Exact dilution flows which would preclude inferior water quality may only be determined by observation of the stream at the time it is receiving the expected waste loads.

There are oil fields located in the headwater area of Little Cypress Creek. The limited records available indicate that there is no significant problem of pollution associated with these fields.

WATER PLAN

The Little Cypress Creek Reservoir, tentatively planned at a site in Upshur County, Texas, approximately 10 miles north of Longview, is located so that it could provide useful municipal and industrial water storage for Marshall, Longview, and Gilmer. (See Figure 1). There are other somewhat smaller communities which could be served by municipal and industrial water storage at this site; however, it is not deemed feasible to make quantitative predictions for them.

Longview

The city of Longview is located in east-central Gregg County, almost directly south of the proposed dam site. At present, the municipal water supply system serves an average of 4.0 mgd to an estimated population of 47,000. Water is normally obtained from Cherokee Lake with Big Sandy Creek serving only as an emergency source of supply.

Pumping costs from Big Sandy Creek limit its use as a permanent source of supply. The total transmission distance is about 21 miles. Water is pumped through a 16-inch main to a reservoir between the intake and Longview and is then released from the reservoir through a 12-inch line to the Longview Water Treatment Plant. The capacity of the line is limited to 3 mgd. Cost of pumping alone, using an energy cost of only 1 per cent KWH, adds up to about 15 cents per 1,000 gallons.

When, in 2010, Longview reaches a population of about 165,000 the municipal (nonindustrial) demand is expected to reach approximately 25 mgd. At the same time, industrial water requirements are expected to approach 44 mgd. The total Longview area requirements will then be 69 mgd of which about 20 mgd will be obtained from other sources developed by industries specifically for their own use.

Longview will not be compelled to expand its water supply until such time as the demand reaches the economical operating limit of the existing 24" transmission facilities. Various schemes were considered for supplying the 49 mgd municipal and industrial water which it is predicted will eventually be required in the Longview area.

Two plans appeared reasonable. These are:

1. Utilization of the present source, Cherokee Lake, to supply the entire future demand was considered.

The plan would entail maintaining the present 24-inch main to carry about 6 mgd and construction of a parallel 48-inch transmission main and appurtanences to handle 43 mgd.

2. Utilization of the existing line to Cherokee Lake to supply 6 mgd and construction of a 48-inch line to supply 43 mgd from Little Cypress Creek Reservoir.

Comparing the two plans, the value of storage to Longview in the proposed Little Cypress Creek Reservoir yielding 43 mgd of municipal and industrial water is estimated to be 1.06 cents per 1,000 gallons.

Marshall

The city of Marshall is located in central Harrison County, approximately 25 miles southeast of the proposed dam site. The present water supply system provides an average of 2.5 mgd to an estimated population of 27,000. A transmission line, having a capacity of 3.0 mgd supplies water from an intake on a tributary of Caddo Lake.

The city's expected growth to 100,000 in 2010 will be accompanied by an increased municipal and industrial water demand. Of the total need at that time of 45 mgd, approximately 15 mgd will be municipal requirements and the remaining 30 mgd will meet the expected industrial demand. By continuing to make use of the 3 mgd available from the Caddo Lake source, Marshall will need an additional 42 mgd for predicted municipal and industrial demand.

The existing Ferrells Bridge Reservoir, approximately 14 miles northwest of Marshall, should be capable of furnishing the future water supply needs for Marshall. However, a reasonable alternate to the construction of a 14 mile, 48-inch line to the Ferrells Bridge impoundment would be a 7.5 mile 48-inch line to Little Cypress Creek downstream from the proposed project site. Water released from the proposed reservoir could be withdrawn at this point.

The value of storage at the Little Cypress Creek Reservoir for a yield of 42 mgd municipal and industrial water supply for the Marshall area is 0.7 cents per 1,000 gallons. This value is based upon the cost of storage at Ferrells Bridge plus the unit saving in construction and operation of the shorter transmission line.

Gilmer

The community of Gilmer with a present population of 4,306 lies approximately 12 miles west of the proposed dam site, in central Upshur County. Four wells, producing a yield of 2.0 mgd presently serve as Gilmer's source of water supply.

It is predicted that Gilmer will have a population of 16,000 in the year 2010. Its municipal and industrial water requirements are expected to reach 6.0 mgd by that time -- 2.4 mgd municipal use and the remaining 3.6 mgd devoted to industrial purposes.

Gilmer could meet the added 4.0 mgd water requirements by developing more wells. The estimated cost of these wells is slightly less than the cost of transmitting water from the proposed Little Cypress Reservoir. Hence, storage in the proposed project would be of no benefit. Be that as it may, there is interest in the Gilmer area in developing a surface source of supply.

Use of storage in the proposed project for municipal and industrial water compares favorably with the independent development of a surface source of supply by the Gilmer area. The cost of constructing a water supply impoundment by the community is just slightly less than the cost of building and operating a transmission line from the proposed dam site to Gilmer. Further, the cost of the separate surface source would be increased by the amount needed to transmit the impounded water to Gilmer. Either water supply system would require a treatment plant.

Impoundment Protection

Municipal and industrial wastes from the Gilmer area are discharged to Little Cypress Creek. Even with improved waste treatment and waste disinfection equipment and techniques, the increased waste loading to be thrust upon the stream will eventually exceed its waste assimilating capacity during periods of low flow. It would, therefore, seem desirable from two standpoints to bypass Gilmer's treated waste around the proposed impoundment. The first is the assuring of the stored water's quality by removing a source of pollution; while the second is the removal of Gilmer's waste to a point at which the stream's capacity to handle treated wastes can be aided by discharges from the proposed impoundment.

APPENDIX

EXHIBIT A

Basic Data Used in Calculations

Pipelines and Wells	Size	Length or Depth	Cost Per Foot in Place	Average Pumping Rate (mgd)	Energy Cost (¢/KWH)
Longview to Lake Cherokee	48"	11 mi.	$33.50	43	1.2
	24"	11 mi.	existing	6	1.2
Longview to Little Cypress Creek Reservoir	48"	10 mi.	$33.50	43	1.2
Marshall to Ferrells Bridge	48"	14 mi.	$33.50	42	1.2
Marshall to Cypress Creek	48"	7.5 mi.	$33.50	42	1.2
10 Wells at Gilmer	10"	600 ft. (Pumping level at 240 feet)	------	0.50 each	1.2
Gilmer to Little Cypress Reservoir Intake	24"	9 mi.	$12.60	4.0	1.2

Cost of storage at Lake Cherokee: 1¢/1,000 gal.

Cost of storage at Ferrells Bridge: 0.14¢/1,000 gal.

BIBLIOGRAPHY

1. U. S. Congress, Red River, La., Ark., Okla., and Tex., 69th Congress, 1st Session, House Document 308.

2. Corps of Engineers, Drainage Area Data, Arkansas, White & Red River Basins, Tulsa, November, 1954.

3. Corps of Engineers, Stages and Discharges of the Mississippi River and Tributaries and Other Streams and Waterways in the New Orleans District.

4. U. S. Bureau of Mines, Minerals Yearbook, 1958 to 1952.

5. Oil and Gas Journal, Review and Forecast Issue, January 25, 1960.

6. Texas Forest Industries Committee, Texas Forest Facts, 1957.

7. U. S. Bureau of Census, Census of Agriculture: Texas, 1954, 1950.

8. Texas Employment Commission, "Report on Employment and Wages by Employees Subject to the Texas Unemployment Compensation Act," 1959-1953.

9. U. S. Bureau of Census, Census of Manufactures, 1947, 1954, 1958.

10. Texas Employment Commission, "Population and Labor Force Estimates of Texas Counties," 1959-1955.

11. U. S. Bureau of Census, Census of Business Retail, Wholesale, and Service, 1948, 1954, 1958.

12. U. S. Bureau of Census, Population Census, 1930-1950.

13. Texas Board of Water Engineers, Water Requirements Survey for Texas, Bulletin 5910, Austin, Texas, (July, 1959).

14. University of Texas, Bureau of Business Research, Water for the Future, Austin, Texas, 1956.

15. U. S. Geological Survey, Water Quality Papers.

16. U. S. Public Health Service, Drinking Water Standards, Washington, D. C., 1946.

17. Arkansas-White-Red Basins Inter-Agency Committee, Arkansas-White-Red River Basins, Part II, Section 8, Domestic and Industrial Water Supply, 1955.

18. Texas Board of Water Engineers, Texas Water Resources Planning at the End of the Year 1958, Austin, Texas, December, 1958.

19. U. S. Geological Survey, Water Supply Papers.

20. Texas Board of Water Engineers, Water Use Reported by Municipalities and Industries in Texas, Austin, Texas, June, 1958.

21. U. S. Public Health Service, 1957 Inventory Municipal and Industrial Waste Facilities, Texas, U. S. Government Printing Office, 1959.

22. U. S. Public Health Service, Report on Water Pollution, Sabine River Basin, Dallas, Texas, April, 1952.

23. Texas Almanac and State Industrial Guide, A. H. Belo Corporation, Dallas, Texas, 1958.